

USE OF A FISH TRANSPORTATION BARGE FOR INCREASING
RETURNS OF STEELHEAD IMPRINTED FOR HOMING

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By

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ABSTRACT

In 1982, the National Marine Fisheries Service began a 6-year study to determine if transporting steelhead, Salmo gairdneri, smolts by barge from Dworshak National Fish Hatchery (NFH) to a release site on the Columbia River below Bonneville Dam would result in increased returns of adults to the various fisheries and to the hatchery homing site.

During 1982 and 1983, over 500,000 juveniles were marked and serially released as controls from the hatchery or barged as test fish to below Bonneville Dam. As of July 1986, returns of adults to various recovery sites from juveniles released in 1982 are virtually complete. Returns of one- and two-ocean fish from the 1983 release are nearly complete. There will be some three-ocean returns due during the 1986-87 steelhead migration, but these probably will not materially affect the results noted to date.

The 1983 test releases showed much less homing impairment and delay in upstream migration than 1982 releases. Most adults from both control and test releases in 1983 and control releases in 1982 migrated a considerable distance upstream and overwintered in the Snake and Clearwater Rivers--behavior similar to Clearwater River fish previously transported from Lower Granite Dam. In contrast, many of the adults from test releases in 1982 failed to migrate upstream very far in the fall and overwintered in the Columbia River.

Survival of control fish released at Dworshak NFH in late April 1982 was substantially higher than survival of those released in mid-May. Survival and homing of control fish released in late April (20 April) and early May (3 May) of 1983 were over 10 times more than for fish released on 24 and 25 May 1983.

Survival of adults from control releases in 1982 was the best ever observed at Dworshak NFH. The lower recovery rate from 1983 releases more nearly represented the normal return to the hatchery. Higher survival in 1982 may have resulted because 57% of the control fish were collected at Lower Granite Dam and received the survival enhancement of being barged around the dam complex. In contrast, only 29% of the control fish were given that assist in 1983.

Survival of fish transported from the hatchery in 1983 was significantly enhanced as indicated by the approximate 4: 1 transport to control ratio observed at Bonneville Dam and in the fall fishery in Zone 6. Less survival enhancement was noted in returns from those transported from the hatchery in 1982. This may have resulted because of the abnormally high rate of return of control fish resulting from the large numbers transported from Lower Granite Dam in 1982. Actual transport benefit may have been comparable since the rates of return of test fish to all sampling sites were similar for both 1982 and 1983 releases.

CONTENTS

	PAGE
INTRODUCTION	1
METHODS	2
Juvenile Releases	2
Adult Collection Facilities at Dams	4
Sampling in Fisheries and Hatcheries	7
RESULTS AND DISCUSSION	8
Adult Returns from 1982 Smolt Releases	8
Survival of Control Groups	8
Survival and Homing of Test Groups	10
Adult Returns from 1983 Smolt Releases	17
Survival of Control Groups	17
Survival and Homing of Test Groups	20
SUMMARY AND CONCLUSIONS	28
ACKNOWLEDGMENTS	30
LITERATURE CITED	31
APPENDIX A - Expenditure Information	32
APPENDIX B - Adult Recovery Summaries	34

INTRODUCTION

The National Marine Fisheries Service (NMFS) began a 6-year study in 1982 under contract to the Bonneville Power Administration to determine if transporting steelhead, Salmo gairdneri, smolts directly from Dworshak National Fish Hatchery (NFH) to a release point below Bonneville Dam on the Columbia River would increase returns of adults to the hatchery and various fisheries. In 1982 and 1983, eight groups of approximately 30,000 juvenile steelhead each were marked and released each year for the study.

The primary objectives of this study are as follows:

1. Determine if steelhead reared and imprinted at Dworshak NFH; transported by truck to a transfer site near Lewiston, Idaho; transferred into a barge; and transported to a release site in the Columbia River below Bonneville Dam and released will return as adults to the hatchery and to the various fisheries in greater numbers than fish released directly into the river at the hatchery.
2. Determine the proportion of fish in each test release that have accepted a homing imprint.
3. Determine the relationship between the physiological condition of steelhead and their ability to imprint (data to be analyzed later and discussed in a subsequent report).

In this report, survival enhancement from transportation is based on test to control (T/C) ratios of adult recoveries in the lower river (Bonneville Dam or the Zone 6 Indian fishery); e.g., if the T/C ratio was 3:1, survival of transported fish was three times that of control fish that migrated through

the dam complex. Such measures in this experiment provided only minimal estimates of enhancement because 57% of the control releases in 1982 and 29% of the control releases in 1983 received survival enhancement by also being transported around the dam complex from downstream collection and transport sites located at Lower Granite and Little Goose Dams.

The proportion of fish in each test release that did not receive a homing imprint is based on the difference in the T/C ratios between fish returning to the lower river and to successive sampling sites as fish progressed upriver on their return trip to the hatchery. Thus, if the T/C ratio was 3:1 at Bonneville Dam and 1:1 at the hatchery, 67% of the test fish failed to receive a homing imprint that enabled them to return to the hatchery.

Since August 1983, we have been monitoring returning adult steelhead to: (1) our adult collection facilities at Bonneville, McNary, and Lower Granite Dams; (2) the sport fishery on the Columbia, Snake, and Clearwater Rivers; (3) the Zone 6 and Clearwater River Indian fisheries; and (4) the Dworshak NFH homing site. This report summarizes adult recovery efforts through July 1986. Information regarding Objective 3 "Determine the relationship between the physiological condition of steelhead and their ability to imprint" will be analysed after all returns are complete and discussed in the final report.

METHODS

Juvenile Releases

Three groups of about 30,000 steelhead each were marked and released from Dworshak N~~EF~~H into the mainstem of the Clearwater River on 19 and 30 April and on 19 May 1982 (Table 1). These groups of fish were designated as control

Table 1. --Steelhead marked in 1982 at Dworshak National Fish Hatchery.

Test number	Co&d wire tag code	Brand	Marked fish released	Unmarked fish released	Date released from hatchery	Treatment	
Control (C1)	23-6-6	LAK-3	29,838	5,883	4-19-82	Released as normal hatchery production into the Clearwater River.	
Test (T1)	23-6-8	RAL-4	33,012	5,207	4-19-82	Trucked directly from hatchery to Clearwater River near Lewiston ID, held in barge for approx. 16 h, and barged for release below Bonneville Dam.	
Test (T1A)	23-6-7	RAL-3	32,185	4,237	4-19-82	Pumped from System II to raw water in another raceway and held for 6 days. Then trucked directly from the hatchery to Clearwater River near Lewiston, ID, held in barge approx. 16 h, and barged for release below Bonneville Dam.	
Control (C2)	23-16-4	LAK-2	31,048	3,094	4-30-82	Released as normal hatchery production into the Clearwater River.	3
Test (T2)	23-16-5	RAL-2	32,911	3,776	4-30-82	Trucked directly from hatchery to Clearwater River near Lewiston, ID, held in barge for approx. 16 h, and barged for release below Bonneville Dam.	
Control (C3)	23-16-2	LAK-1	31,714	3,629	5-19-82	Released as normal hatchery production into the Clearwater River.	
Test (T3)	23-16-3	RA) (-1	29,456	3,636	5-19-82	Trucked directly from hatchery to Clearwater River near Lewiston, ID, held in barge for approx. 16 h, and barged for release below Bonneville Dam.	
Test (T4)	23-16-1	RAL-1	31,915	3,051	5-31-82	Trucked directly from hatchery to Clearwater River near Lewiston, ID, held in barge for approx. 16 h, and barged for release below Bonneville Dam.	
		TOTAL	252,079	32,513			

releases. Five additional groups of about 30,000 steelhead each were marked and transported by truck to a barge at Lewiston, Idaho, on 19 and 30 April and 19 and 31 May 1982 and then transported by barge around the dam complex and released below Bonneville Dam (Table 1). These groups were designated as test releases. For the first release date (19 April), a second test group was pumped from one raceway to another before being transported (Harmon and Slatick 1983).

During the spring of 1983, three control groups of about 30,000 steelhead each were marked and released from Dworshak NFH into the main stem of the Clearwater River on 20 April and 3 and 25 May (Table 2). An additional control group of approximately 30,000 marked fish was pumped into the North Fork of the Clearwater River on 3 May. Four test groups of approximately 30,000 fish each were marked and transported by truck to a barge at Lewiston, Idaho, on 20 April and 3 and 24 May 1983 and then transported by barge around the dam complex and released below Bonneville Dam (Table 2). For the first release date (20 April), a second test group was pumped from one raceway to another before being transported (Harmon and Slatick 1984).

The general health and status of smoltification of each experimental group were monitored from March until they were released from the hatchery or transported by barge. This portion of the study was done by subcontract with the U.S. Fish and Wildlife Service, Ahsahka, Idaho.

Adult Collection Facilities at Dams

Adult collection facilities at Bonneville and McNary Dams on the Columbia River and Lower Granite Dam on the Snake River were operated during the fall of 1983, 1984, and 1985. The sampling site at Lower Granite Dam was also

Table 2.--Steelhead marked in 1983 at Dworshak National Fish Hatchery.

Test number	Coded wire tag code	Brand	Marked fish released	Unmarked fish released	Date released from hatchery	Treatment
Control (C1)	23-16-38	LAW-1	33,178	113	4-20-83	Released as normal hatchery production into the mainstem Clearwater River.
Test (T1)	23-16-40	RAF-1	30,341	165	4-20-83	Trucked directly from hatchery to Clearwater River near Lewiston, ID; held in barge for approx. 16 h; and barged for release below Bonneville Dam.
Test (T1A)	23-16-39	RAZ-1	28,658	133	4-20-83	Pumped to another pond and held for 7 days; then trucked directly from the hatchery to Clearwater River near Lewiston, ID; held in barge approx. 16 h; and barged for release below Bonneville Dam.
Control (C2)	23-16-16	LAW-2	32,236	8,128	5-3-83	Released as normal hatchery production into the mainstem Clearwater River.
Control (C2A)	23-16-19	RAP-3	31,956	1,378	5-3-83	Released (pumped) as normal hatchery production into the North Fork Clearwater River.
Test (T2)	23-16-17	RAF-2	32,456	2,242	5-3-83	Truck directly from hatchery to Clearwater River near Lewiston, ID; held in barge for approx. 16 h; and barged for release below Bonneville Dam.
Control (C3)	23-16-20	RAF-4	30,751	219	5-25-83	Released as normal hatchery production into the mainstem Clearwater River.
Test (T3)	23-16-18	LAW-3	<u>31,906</u>	<u>2,703</u>	5-24-83	Trucked directly from hatchery to Clearwater River near Lewiston, ID; held in barge for approx. 16 h; and barged for release below Bonneville Dam.
		TOTAL	251,491	15,081		

monitored during the spring of 1984, 1985, and 1986 since many Dworshak NFH steelhead overwinter in the Snake River below Lower Granite Dam before continuing their migration to the Clearwater River. The operation of all three collection facilities was similar; however, at Bonneville and McNary Dams, the sampling sites were located in the north fishways only, and hence only a small portion of the Snake River steelhead population was sampled. At Lower Granite Dam virtually the entire Snake River run was sampled.

These in-river collection facilities provided separation of tagged fish from the untagged adult population. Fish entering the trapping area passed over a false weir and slid downward through a detection coil into a smooth horizontal trough. If the fish was tagged, the magnetic field was interrupted, and a signal was transmitted to a solenoid that activated an air ram that operated a gate which shunted the tagged fish to a holding area (Durkin et al. 1969; Ebel 1974). Fish that were not tagged were simply diverted back to the main fishway. Tagged fish were removed from the holding area with a dipnet, placed in an anesthetic tank, anesthetized, measured, jaw tagged, and identified by brand. By reading the freeze brand applied when the fish were juveniles, fish from individual treatment groups were identified. Fish were then allowed to recover in fresh water before being released. The fish were jaw tagged for identification and recovered in the various fisheries and at hatcheries (Gilbreath et al. 1976; Slatick 1976). Some fish were recovered more than once; recaptured fish were included in all data summaries (eg., at Lower Granite Dam and Dworshak NFH). When all adults have returned and the final analysis is completed, comparisons will be made between treatment (experimental) groups in each recovery area and thus all fish recovered can be used whether recaptured or not. From these recoveries, straying can be

identified and trapping efficiencies can be estimated for expansion of return percentages.

Sampling in Fisheries and Hatcheries

Sampling in the sport and Indian fisheries began during the fall of 1983 and continued through July 1986. Recoveries were also monitored at Dworshak NFH each spring from 1983 through 1986.

The area with the largest concentrations of fishing pressure and fish (Clearwater River and the Snake River near its confluence with the Clearwater River) received the majority of our sampling effort in the sport fishery. Recoveries came from sport fishermen in the form of jaw tags and fish snouts containing coded wire tags (CWT).

Most recoveries from the Columbia River Zone 6 fall and winter Indian fishery came from sampling by the Oregon Department of Fish and Wildlife and the Washington Department of Game. We also received voluntary recoveries from tribal members fishing the Clearwater River in Idaho.

Adult steelhead entered Dworshak NFH through a fish ladder and were held in adult holding ponds until mature enough to spawn. Generally, hatchery personnel checked each fish weekly. If the fish was not ripe, it was returned to one of the holding ponds to be checked the following week. Mature fish were killed, spawned, and checked for a CWT. All snouts from tagged fish were retained for extraction and decoding of the CWT at a later date. When returns are complete comparisons will be made between control groups to evaluate the best time frame to release steelhead directly from Dworshak NFH. Comparisons between test groups and with control groups should also indicate the best time for transporting fish from the hatchery.

RESULTS AND DISCUSSION

Adult Returns from 1982 Smolt Releases

Recoveries from 1982 test and control releases total 4,339 fish and are essentially complete. All three year classes of adults have returned to all recovery sites. A few late recoveries are expected from sport fishermen and state and federal agencies. These late recoveries likely will not affect the results of the experiment but will be included in the final report. The total number of fish and the percent return of adults from juvenile releases are not directly comparable between sampling sites because of differing sampling intensities. However, T/C ratios are directly comparable between experimental groups within and among sampling sites. A summary of recoveries from each experimental group is presented in Appendix Tables B1-B8.

The additional 199 fish recovered since 1985 did not change any of the findings previously reported by Harmon and Slatick (1986). A brief summary of those findings is presented next, along with updated tables incorporating all recoveries of marked fish through July 1986.

Survival of Control Groups

Table 3 shows the percentage of adults recaptured from juveniles released as controls from Dworshak NFH in 1982 at Bonneville, McNary, and Lower Granite Dams; in the Indian and sport fisheries; and at the Dworshak NFH homing site. At all recovery locations, releases of juveniles from both the first release (19 April) and the second release (30 April) had a much higher rate of return than those from the third release (19 May). At two sampling sites, Dworshak NFH and Bonneville Dam, the second release showed the best return rates.

Table 3.--A comparison of adult steelhead from three control groups of juveniles that were released into the mainstem of the Clearwater River from Dworshak National Fish Hatchery (NFH) in 1982. Preliminary recoveries through 1986.

Recovery locations	% of juvenile releases recovered as adults ^{a/}		
	19 April release	30 April release	19 May release
Bonneville Dam	0.563	0.718	0.423
Indian fishery	0.526	0.515	0.375
McNary Dam	0.070	0.032	0.040
Lower Granite Dam	1.639	1.594	1.044
Sport fishery	0.375	0.415	0.180
Dworshak NFH	0.680	0.821	0.410

^{a/} Because of differences in sampling intensity at each recovery site, return rates are not comparable between sites.

These data indicate that survival of steelhead released directly from Dworshak NFH in 1982 was best for fish released in late April. Releases on 19 May had drastically reduced survival. It should be noted that the rates of return shown are not indicative of survival of fish passing downstream through the dam complex in 1982 because approximately 57% of these fish had the benefit of transportation from either Lower Granite, Little Goose, or McNary Dams to below Bonneville Dam as part of the U.S. Army Corps of Engineers' (COE) annual transport program (Harmon and Slatick 1983).

Survival and Homing of Test Groups

Recoveries of all three year classes of adult steelhead from juveniles released in 1982 to Bonneville, McNary, and Lower Granite Dams are shown in Table 4. Most of these recoveries were recaptured in the fall of 1984 and the spring of 1985 as two-ocean adults. Fish from the first control group released on 19 April returned to Bonneville Dam at a higher rate than either test groups released on that date. Test to control ratios were 0.80:1 for the first test group and 0.67:1 for the pumped group (Test T1A). In contrast, test fish from the second and third groups released on 30 April and 19 May, respectively, returned at higher rates than controls (indicating better survival) as shown by T/C ratios of 1.39: 1 and 2.54: 1, respectively. Returns of test fish from the fourth release (31 May) were poorest, with a test to control ratio of 0.46: 1 (test fish were compared to control fish in the third release). The positive T/C ratios for most release groups at downriver sampling sites (Bonneville and McNary Dams), even with 57% of the controls also transported, provide strong evidence that survival can be significantly enhanced by direct transport from the hatchery.

Table 4.--Returns of one-, two-, and three- ocean adult steelhead to Bonneville, McNary, and Lower Granite Dams from juveniles released in the spring of 1982 from Dworshak National Fish Hatchery. Preliminary recoveries **through** July 1986.

			Adult recoveries														
			Bonneville Dam ^{a/}			Mc Nary Dam ^{a/}			Lower Granite Dam ^{a/}								
									Tall returns			Spring returns			Total returns		
Test No.	Date juveniles released	Number juveniles released	N	%	Test to control ratio	N	x	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio
1982 Release																	
Control (C1)	19 Apr 82	29,838	168	0.563		21	0.070		387	1.297		102	0.342		489	1.639	
Test (T1)	19 Apr 82	33,012	149	0.451	0.80:1	53	0.161	2.30:1	48	0.145	0.11:1	158	0.479	1.40:1	206	0.624	0.38:1
Test (T1A)	19 Apr 82	32,185	121	0.376	0.67:1	24	0.074	1.06:1	33	0.103	0.08:1	111	0.345	1.01:1	144	0.447	0.27:1
Control (C2)	30 Apr 82	31,048	223	0.718		10	0.032		360	1.159		135	0.435		495	1.594	
Test (T2)	30 Apr 82	32,911	329	1.000	1.39:1	49	0.149	4.66:1	129	0.392	0.34:1	285	0.866	1.99:1	414	1.258	0.79:1
Control (C3)	19 May 82	31,714	134	0.423		13	0.040		259	0.817		77	0.227		331	1.044	
Test (T3)	19 May 82	29,456	317	1.076	2.54:1	36	0.122	3.05:1	62	0.210	0.26:1	229	0.777	3.42:1	291	0.986	0.95:1
Test (T4)	31 May 82	31,915	<u>62</u>	0.194	0.46:1 ^{b/}	<u>17</u>	0.053	1.33:1 ^{b/}	11	0.034	0.04:1 ^{b/}	<u>69</u>	0.216	0.95:1 ^{b/}	<u>80</u>	0.251	0.24:1 ^{b/}
Totals		252,079	1,503			223			1,289			1,161			2,450		

^{a/} Sampling intensity differed between sites, therefore, only test to control ratio should be used for comparisons.

^{b/} Since no control group was released with Test T4 it was compared to Control C3 to obtain the test to control ratio.

Recoveries to Lower Granite Dam showed that recapture of control fish during the fall were much higher than test fish which is reflected in low T/C ratios ranging from 0.04:1 to 0.34:1. In contrast, spring returns show much more positive T/C ratios for each test release. Ratios range from 0.95:1 to 3.42:1, with the second and third groups showing the highest benefits of 1.99:1 and 3.42:1, respectively. Total returns to Lower Granite Dam (fall and spring returns combined) show T/C ratios of 0.38:1 and 0.27:1 for the first release, 0.79:1 for the second release, 0.95:1 for the third release, and 0.24:1 for the fourth release (Table 4). The high T/C ratio for the third release group (0.95:1) was probably more the result of poorer survival of the third control group rather than better homing of the test fish. The difference between recoveries in the fall and spring was caused by many of the test fish delaying their migration and overwintering in the Columbia River.

Recoveries of steelhead in the fall and winter Zone 6, ceremonial, and Clearwater River Indian fisheries from juvenile releases in 1982 are summarized in Table 5. Returns from the fall Zone 6 Indian fishery were very similar to returns to Bonneville Dam whereas recoveries from the winter Zone 6 fishery indicated there may have been some homing impairment or delay in migration of fish that were barged as test fish. Test to control ratios were 5.38:1 and 6.46:1 for the first release, 7.88:1 for the second release, 18.31:1 for the third release, and 3.38:1 for the last release. These high benefit ratios suggest that many test fish but few control fish overwintered in the Columbia River and were available to the winter Indian fishery. In contrast, most of the control fish from each release seemed to move through the Columbia River during the fall and overwintered in the Snake and Clearwater Rivers and were unavailable to the winter Indian fishery in the

Table 5.--Returns of one-, two-, and **three-** ocean adult steelhead to the fall and winter Zone 6, ceremonial, and Clearwater River Indian fisheries **from** juveniles released in the spring of 1982 from Dworshak National Fish **Hatchery**. Preliminary results through July 1986.

Test no.	Date juveniles released	Number juveniles released	Adult recoveries													
			Fall Zone 6			Winter Zone 6			Ceremonial			Clearwater			Total	
			Total		Test to control ratio	Total		Test to control ratio	Total		Test to control ratio	Total		Test to control ratio	Total	
			N	%		N	%		N	%		N	%		N	%
1982 Releases																
Control (C1)	19 Apr 82	29,838	138	0.462		4	0.013		1	0.003		14	0.047		157	0.526
Test (T1)	19 Apr 82	33,012	130	0.394	0.85:1	23	0.070	5.38:1	0			5	0.015	0.32:1	158	0.479 0.91:1
Test (T1A)	19 Apr 82	32,185	123	0.382	0.83:1	27	0.084	6.46:1	3	0.009	3.10:1	5	0.016	0.34:1	158	0.491 0.93:1
Control (C2)	30 Apr 82	31,048	140	0.451		10	0.032		0			10	0.032		160	0.515
Test (T2)	30 Apr 82	32,911	268	0.814	1.80:1	83	0.252	7.88:1	6	0.018		10	0.030	0.94:1	367	1.115 2.17:1
Control (C3)	19 May 82	31,714	105	0.331		4	0.013		0			10	0.032		119	0.375
Test (T3)	19 May 82	29,456	184	0.625	1.89:1	70	0.238	18.31:1	9	0.031		9	0.031	0.97:1	272	0.625 1.67:1
Test (T4)	31 May 82	<u>31,915</u>	<u>54</u>	<u>0.169</u>	<u>0.51:1^{a/}</u>	<u>14</u>	<u>0.044</u>	<u>3.38:1^{a/}</u>	<u>1</u>			<u>2</u>	<u>0.006</u>	<u>0.19:1^{a/}</u>	<u>70</u>	<u>0.219 0.58:1^{a/}</u>
Totals		252,079	1,142			235			19			65			1,461	

^{a/} Since no control group was released with Test T4 it was compared to Control C3 to obtain the test to control ratio.

Columbia River. This was confirmed by the large numbers of control fish from each group that were recaptured in the fall at Lower Granite Dam (Table 4) and in the sport fishery on the Snake and Clearwater Rivers (Table 6).

The recoveries in the sport fishery on the Snake and Clearwater Rivers were substantially higher than for the Columbia River reflecting a more intensive fishery in these areas which are also in proximity to the homing site. However, T/C ratios were much lower in the Snake River, (0.21:1 to 0.60:1) as compared to 0.88:1 to 3.00:1 on the Columbia River below the Snake River. The lower ratios as one proceeds upriver were due to the fact that the majority of the control fish arrived in the Snake and Clearwater Rivers during the fall whereas most test fish arrived during the spring of the following year. Therefore, more fish from control groups were in the Snake and Clearwater Rivers for a longer period of time than test fish, making the control fish more susceptible to harvest in the sport fishery.

A total of 1,239 test and control fish from 1982 juvenile releases were recovered at the Dworshak NFH homing site (Table 7). The 0.77:1 T/C ratio and 0.63 rate of recovery for the second release are encouraging. Had not 57% of the controls been transported from Lower Granite Dam, their percentage return may have ended up considerably less than the percentage return of fish transported from the hatchery.

In summary, data from adult returns of 1982 smolt releases indicated survival of test fish was increased by transportation of smolts from the hatchery, there was some homing impairment, and survival and homing were best when steelhead smolts were released or transported from the hatchery near the first of May.

Table 6.--Returns of one-, two-, and three- ocean adult steelhead to the Columbia, Snake, and Clearwater Rivers in the sport fishery from juveniles released in the spring of 1982 from Dworshak National Fish Hatchery. Preliminary recoveries through July 1986.

Test no.	Date juveniles released	Number juveniles released	Adult recoveries														
			Columbia R. below Snake R.			Columbia R. above Snake R.			Snake R.			Clearwater R.			Total		
			Total		Test to control ratio	Total		Test to control ratio	Total		Test to control ratio	Total		Test to control ratio	Total		Test to control ratio
			N	%		N	%		N	%		N	%		N	%	
1982 Releases																	
Control (C1)	19 Apr 82	29,838	5	0.017		1	0.003		40	0.134		66	0.221		112	0.375	
Test (T1)	19 Apr 82	33,012	5	0.015	0.88:1	0	0.000		10	0.030	0.22:1	5	0.015	0.07:1	20	0.061 0.19:1	
Test (T1A)	19 Apr 82	32,185	7	0.022	1.29:1	0	0.000		9	0.028	0.21:1	9	0.028	0.13:1	25	0.078 0.21:1	
Control (C2)	30 Apr 82	31,048	6	0.019		0	0.000		55	0.177		68	0.219		129	0.415	
Test (T2)	30 Apr 82	32,911	10	0.030	1.58:1	0	0.000		23	0.070	0.40:1	17	0.052	0.24:1	50	0.152 0.37:1	
Control (C3)	19 May 82	31,714	3	0.009		0	0.000		18	0.057		36	0.114		57	0.180	
Test (T3)	19 May 82	29,456	8	0.027	3.00:1	0	0.000		10	0.034	0.60:1	7	0.024	0.21:1	25	0.085 0.47:1	
Test (T4)	31 May 82	31,915	2	0.006	0.67:1 ^{a/}	0	0.000		7	0.022	0.39:1 ^{a/}	1	0.003	0.03:1 ^{a/}	10	0.031 0.17:1 ^{a/}	
Totals		252,079	46			1			172			209			428		

^{a/} Since no control group was released with Test T4 it was compared to Control C3 to obtain the test to control ratio.

Table 7.--Returns of one-, and two-, and three- ocean adult steelhead to the Dworshak National Fish Hatchery homing site from juveniles released in the spring of 1982 from Dworshak National Fish Hatchery. Preliminary recoveries through July 1986.

Test no.	Date juveniles released	Number juveniles released	Adult recoveries					
			<u>1-ocean</u> N	<u>2-ocean</u> N	<u>3-ocean</u> N	Total		
						N	%	Test to control ratio
<u>1982 Releases</u>								
Control (C1)	19 Apr 82	29,838	10	190	3	203	0.680	
Test (T1)	19 Apr 82	33,012	8	114	3	125	0.379	0.56:1
Test (T1A)	19 Apr 82	32,185	4	101	2	107	0.332	0.49:1
Control (C2)	30 Apr 82	31,048	12	237	6	255	0.821	
Test (T2)	30 Apr 82	32,911	11	196	1	208	0.632	0.77:1
Control (C3)	19 May 82	31,714	6	115	9	130	0.410	1.39:1
Test (T3)	19 May 82	29,456	13	150	5	168	0.570	
Test (T4)	31 May 82	<u>31,915</u>	<u>2</u>	<u>38</u>	<u>3</u>	<u>43</u>	0.135	0.34:1 ^{a/}
Totals		252,079	66	1,141	32	1,239		

^{a/} Since no control group was released with Test T4 , it was compared to Control C3 to obtain the test to control ratio.

Adult Returns from 1983 Smolt Releases

Recoveries from 1983 test and control releases include one- and two-ocean returns. Three-ocean fish will return during the 1986-87 steelhead migration. The total number of fish and the percent return of adults from 1983 juvenile releases are not directly comparable between sampling sites because of differing sampling intensities. However, T/C ratios are comparable as stated earlier for 1982 releases. A summary of recoveries from each experimental group is presented in Appendix Tables B9-B16.

Survival of Control Groups

Table 8 shows the percentage of adults recaptured from juveniles released as controls from Dworshak NFH in 1983 at Bonneville, McNary, and Lower Granite Dams; in the Indian and sport fisheries; and at the Dworshak NFH homing site. Two control groups were released at different locations. on 3 May to verify that the normal hatchery release site (mainstem) for the past several years has not been adversely impacting survival or homing. Returns from both the main stem and North Fork Clearwater River releases were similar in rate of return to all sampling sites. The nearly identical rates of return to the hatchery (0.273 vs 0.297) indicate the main stem release site is as effective as the North Fork Clearwater release site. A similar but slightly higher rate of return was noted for the 20 April release. In contrast, though, the rate of return for the 25 May release to all recovery sites was only about 10% of the earlier releases. In 1982, highest survival was also obtained for the late April and early May releases. Data from the monitoring of downriver smolt migrations in 1982 and 1983 indicated that as many or more of the late May releases survived to the estuary as earlier releases in both years (Harmon

Table 8.--A comparison of adult steelhead from four control groups of juveniles that were released into the main stem or the North Fork of the Clearwater River from Dworshak National Fish Hatchery (NFH) in 1983. Preliminary recoveries through July 1986.

Recovery locations	% of juvenile releases recovered as adults ^{a/}			
	20 April release	3 May release (main stem)	3 May release (North Fork)	25 May release
Bonneville Dam	0.130	0.065	0.097	0.003
Indian fishery	0.193	0.133	0.228	0.010
McNary Dam	0.021	0.0	0.006	0.0
Lower Granite Dam	0.639	0.583	0.563	0.052
Sport fishery	0.172	0.121	0.153	0.026
Dworshak NFH	0.286	0.273	0.297	0.023

^{a/} Because of differences in sampling intensity at each recovery site, return rates are not comparable between sites.

and Slatick 1983 and 1984). This would indicate that the physiological condition of the fish or conditions in the ocean were not as conducive for survival when the late May release arrived as they were earlier in the year.

Rate of return of adults to the hatchery from the 20 April and 3 May releases in 1983 was about 0.3%. This was less than half that recorded back to the hatchery in 1982 (0.68 and 0.82%, respectively). The return from 1983 more closely represented the 0.15 to 0.29% return of adults to the hatchery from smolts released at the hatchery between 1978 and 1981 (W. Miller ^{1/}). The record high return from 1982 releases was probably a result of a combination of things: (1) unusually high smolt survival [nearly 100% survival from the hatchery to Lower Granite Dam in 1982 as compared to about 50% in most years (Raymond ^{2/})]; (2) added downriver survival resulting from 57% of the control fish being transported from Lower Granite Dam to below Bonneville Dam in 1982, compared to 29% transported in 1983; and (3) possibly higher ocean survival of smolts released in 1982.

When comparing fall and spring recoveries to Lower Granite Dam from 1982 releases, it appears that approximately 25% of the control returns were recovered in the spring (Table 4). In 1983 when only 50% as many control fish were transported around the dams as juveniles, only about 12% of the control

^{1/} W. Miller, U.S. Fish and Wildlife Service, Dworshak Fisheries Assistance Office, Alaska, Idaho 83520, pers. commun. 1986.

^{2/} H. Raymond, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, 2725 Montlake Blvd. E., Seattle, WA 98112, per commun. 1986.

fish were recaptured in the spring (Table 9). This suggests that transportation of juvenile steelhead from Dworshak NFH around dams caused delay in migration of adults on their upstream migration. Our findings agree closely with those reported by Park (1985). In Park's analysis of juvenile steelhead returns following transportation at Little Goose and Lower Granite Dams, he observed that delays in the adult migration were attributable to Dworshak NFH fish in the transported populations. The reason transported Dworshak NFH fish delay during their upstream migration is unclear, but it may relate to the relatively close proximity of the hatchery/stream to downstream collection points.

Survival and Homing of Test Groups

Adult returns from one- and two-ocean steelhead to Bonneville, McNary, and Lower Granite Dams from 1983 juvenile releases at Dworshak NFH are presented in Table 9. Most recoveries are from two-ocean age fish recaptured in the fall of 1985 and the spring of 1986. These are preliminary data, with three-ocean adults due to return in the 1986-87 season.

A positive T/C ratio is shown for each test group at each of the in-river sampling sites. High T/C ratios at downriver sampling sites (Bonneville and McNary Dams) coupled with lower ratios during the fall and high ratios during the spring at Lower Granite Dam indicate some homing impairment. In contrast to 1982, all T/C ratios were positive even upstream as far as Lower Granite Dam. This, together with fewer fish taken in the Zone 6 winter fishery from 1983 releases, would indicate less homing impairment than that experienced by test groups from 1982 releases.

Table 9.--Returns of one- and two- ocean adult steelhead to Bonneville, McNary, and Lower Granite Dams from juveniles released in the spring of 1983 from Dworshak National Fish Hatchery. Preliminary recoveries through July 1986.

			Adult recoveries														
			Bonneville Dam ^{a/}			McNary Dam ^{a/}			Lower Granite Dam ^{a/}								
									Fall returns			Spring returns			Total returns		
Test no.	Date juveniles released	Number juveniles released	N	%	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio
1983 Releases																	
Control (C1)	20 Apr 83	33,178	43	0.130		7	0.021		194	0.585		18	0.054		212	0.639	
Test (T1)	20 Apr 83	30,341	121	0.399	3.07:1	47	0.155	7.38:1	229	0.755	1.29:1	180	0.593	10.98:1	409	1.348	2.11:1
Test (T1A)	20 Apr 83	28,658	158	0.551	4.24:1	50	0.174	8.29:1	226	0.789	1.35:1	196	0.684	12.67:1	422	1.473	2.31:1
Control (C2)	5 May 83	32,236	21	0.065		0	0.0		160	0.496		28	0.087		188	0.583	
Control (C2A)	5 May 83	31,956	31	0.097		2	0.006		155	0.485		25	0.078		180	0.563	
Test (T2)	5 May 83	32,465	131	0.404	6.22:1	40	0.123		256	0.789	1.59:1	190	0.585	6.72:1	446	1.374	2.36:1
Control (C3)	25 May 83	30,751	1	0.003		0	0.0		15	0.049		1	0.003		16	0.052	
Test (T3)	24 May 83	31,906	<u>12</u>	0.038	12.7:1	<u>4</u>	0.013		32	0.100	2.04:1	<u>13</u>	0.041	13.67:1	45	0.141	2.71:1
Totals		251,491	518			150			1,267			651			1,918		

^{a/} Sampling intensity differed between sites, therefore, only test to control ratios should be used for comparisons.

At Bonneville Dam, a total of 518 adult steelhead were recovered through July 1986 from 1983 smolt releases. Test to control ratios of 3.07:1 and 4.24:1 for the first releases (20 April), 6.22:1 for the second release (5 May), and 12.7:1 for the third release (24 May) demonstrate significant survival enhancement of fish transported directly from Dworshak NPH.

Recoveries at McNary Dam had T/C ratios of 7.38:1 and 8.29:1 for the first release. No T/C ratios are shown for the second and third releases because no controls were recaptured from those groups. Even so, test returns look favorable for the second release (40) whereas the third release shows only four recoveries. McNary Dam recoveries total 150 fish through July 1986.

At Lower Granite Dam, 1,267 fish were recovered during the fall and 651 fish were recovered during the spring (Table 9). Positive T/C ratios ranged from 1.29:1 to 2.04:1 for fall returns. As with 1982 returns, much higher T/C ratios (ranging from 6.72:1 to 13.67:1) were recorded for spring returns, indicating that many test fish arrived somewhat later than control fish to Lower Granite Dam because of a delay in migration of transported groups. When fall and spring returns were combined, all three releases had consistent T/C ratios: 2.11:1 and 2.31:1 for the first releases, 2.36:1 for the second release, and 2.71:1 for the third release.

A total of 671 fish were recovered in the fall Zone 6 Indian fishery (Table 10). Test to control ratios were similar to T/C ratios at Bonneville Dam (3.46:1 and 4.41:1 for the first release, 5.16:1 for the second release, and 5.00:1 for the third release). Recoveries in the winter Zone 6 Indian fishery were low. Only 37 fish were recovered from releases in 1983 compared to 235 fish from the 1982 releases. This suggests much less homing impairment for 1983 releases. In contrast to 1982 releases which overwintered in the Columbia River, most of the 1983 releases received sufficient homing cues to

Table 10.--Returns of one- and two- ocean adult steelhead to the fall and winter Zone 6, ceremonial and Clearwater Indian fisheries from juveniles in the spring of 1983 from Dworshak National Fish Hatchery. Preliminary results through July 1986.

			Adult recoveries											
			Fall Zone 6		Winter gone 6		Ceremonial		Clearwater		Total			
Test no.	Date juveniles released	Number juveniles released	Total N	%	Test to control ratio	Total N	%	Test to control ratio	Total N	%	Test to control ratio	Total N	%	Test to control ratio
1983 Releases														
Control (C1)	20 Apr 83	33,178	48	0.144		0						16	0.048	64 0.193
Test (T1)	20 Apr 83	30,341	151	0.498	3.46:1	5	0.016		0			44	0.145	3.02:1 200 0.659 3.41:1
Test (T1A)	20 Apr 83	28,658	182	0.635	4.41:1	9	0.031		1	0.003		40	0.140	2.92:1 232 0.810 4.20:1
Control (C2)	3 May 83	32,236	34	0.105		1	0.003		0			8	0.025	43 0.133
Control (C2A)	3 May 83	31,956	61	0.191		2	0.006		0			10	0.031	73 0.228
Test (T2)	3 May 83	32,465	176	0.542	5.16:1	18	0.055	18.33:1	0			39	0.120	4.80:1 233 0.718 5.40:1
Control (C3)	25 May 83	30,751	3	0.010		0			0			0		3 0.010
Test (T3)	24 May 83	31,906	16	0.050	5.00:1	2	0.006		0			0		18 0.056 5.60:1
Totals		251,491	671			37			1			157		866

enable them to migrate upstream with minimal delay and overwinter in the Snake and Clearwater Rivers.

Nez Perce Tribal fisherman harvested 157 jaw tagged steelhead from 1983 released fish (Table 10). Test to control ratios are 3.02:1 and 2.92:1 for the first release and 4.80:1 for the second release. No recoveries were made from the third releases.

Returns to the sport fishery are shown in Table 11. Of the 375 fish recaptured, 204 were recovered in the Clearwater River, 124 in the Snake River, and 47 in the Columbia River below the Snake River. No recoveries were made from the Columbia River above the Snake River, indicating that no straying to the upper Columbia River occurred. Test to control ratios from the Columbia River below the Snake River range from 5.50:1 to 8.67:1 for the first two releases. No recoveries were made from the third release. Test to control ratios were lower in the Snake River, ranging from 1.43:1 to 2.21:1. Further reduced T/C ratios were seen upstream in the Clearwater River. Test to control ratios ranged from 0.93:1 to 1.31:1 for the first two releases whereas the third release showed a T/C ratio of 0.13:1, with only eight fish recaptured. These data suggest a delay in migration of test fish resulting in lower T/C ratios as one samples progressively upstream.

The lack of fish taken in the Zone 6 winter fishery from returns of 1983 releases compared to large numbers taken from returns of 1982 fish and much higher T/C ratios for spring recoveries of 1983 fish at Lower Granite **Dam** (about 10:1 on 1983 releases vs about 2:1 on 1982 releases) also suggest that homing was less impaired in the 1983 experiment. Fish returning from the 1983 release did not stay in the Columbia River as did returning fish from the 1982 release. Instead, most had sufficient homing cues to move up into the Snake

Table 11.--Returns of one- and two- ocean adult steelhead to the Columbia, Snake, and Clearwater Rivers in the sport fishery from juveniles released in the spring of 1983 from Dworshak National Fish Hatchery. Preliminary recoveries through July 1986.

			Adult recoveries														
Test No.	Date juveniles released	Number juveniles released	Columbia R. below Snake R.			Columbia R. above Snake R.			Snake R.			Clearwater R.			Total		
			N	%	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio	N	%	Test to control ratio
<u>1983 Releases</u>																	
Control (C1)	20 Apr 83	33,178	2	0.006		0			20	0.060		35	0.105		57	0.172	
Test (T1)	20 Apr 83	30,341	10	0.033	5.50:1	0			26	0.086	1.43:1	42	0.138	1.31:1	78	0.257	1.49:1
Test (T1A)	20 Apr 83	28,658	14	0.049	8.17:1	0			31	0.108	1.80:1	28	0.098	0.93:1	73	0.255	1.48:1
Control (C2)	3 May 83	32,236	2	0.006		0			9	0.028		28	0.087		39	0.121	
Control (C2A)	3 May 83	31,956	2	0.006		0			15	0.047		32	0.100		49	0.153	
Test (T2)	3 May 83	32,465	17	0.052	8.67:1	0			20	0.062	2.21:1	31	0.095	1.09:1	68	0.209	1.73:1
Control (C3)	25 May 83	30,751	0			0			1	0.003		7	0.023		8	0.026	
Test (T3)	24 May 83	<u>31,906</u>	<u>0</u>			0			<u>2</u>	0.006	2.00:1	1	0.003	0.13:1	<u>3</u>	0.009	0.35:1
Totals		251,491	47			0			124			204			375		

River where they overwintered much like the normal returns of Clearwater River fish following transportation from Lower Granite Dam (Park 1985).

The apparent increased ability of 1983 releases to home farther upstream was further reflected in increased T/C ratios for 1983 returns to Dworshak NFH (Table 12). Test to control ratios were 1.90:1 and 2.07:1 for the first releases, 1.93:1 for the second release, and 2.87:1 for the third release. These are comparable to T/C ratios at Lower Granite Dam, indicating minimal homing impairment between these sites. These ratios are very encouraging--indicating that twice as many adults may return to the homing site from juveniles transported from Dworshak NFH compared to fish released directly from the hatchery.

The higher T/C ratios from the 1983 releases to all recovery sites appear to indicate that fish from the 1983 releases had a much more positive survival benefit from transportation than did those from the 1982 release. In fact, while not measurable, benefits may well have been similar had not survival of 57% of the control releases in 1982 been enhanced by transportation from Lower Granite Dam compared to the more normal 29% in 1983. The fact that nearly the same percentage recovery of test fish was noted at all sampling sites for both 1982 and 1983 releases would seem to indicate benefits could well have been comparable.

Returns from 1982 releases are essentially complete. When three-ocean steelhead from 1983 releases return in 1986-87, final conclusions can be drawn from the data.

Table 1 .--Returns of one- and two- ocean adult steelhead to the Dworshak National Fish Hatchery homing site from juveniles released in the spring of 1983 from Dworshak National Fish Hatchery. Preliminary recoveries through July 1986.

Test no.	Date juveniles released	N u m b e r juveniles released	Adult recoveries				Test to control. ratio
			<u>1-ocean</u> No.	<u>2-ocean</u> No.	Total		
					No.		
<u>1983 Releases</u>							
Control (C1)	20 Apr 83	33,178	6	89	95	0.286	
Test (T1)	20 Apr 83	30,341	2	163	165	0.544	1.90:1
Test (T1A)	20 Apr 83	28,658	2	168	170	0.593	2.07:1
Control (C2)	3 May 83	32,236	11	77	88	0.273	
Control (C2A)	3 May 83	31,956	1	94	95	0.297	
Test (T2)	3 May 83	32,465	9	162	171	0.527	1.93:1
Control (C3)	25 May 83	30,751	0	7	7	0.023	
Test (T3)	24 May 83	<u>31,906</u>	<u>0</u>	21	21	0.066	2.87:1
Totals		251,491	31	781	812		

SUMMARY AND CONCLUSIONS

1. In 1982 and 1983, eight groups of about 30,000 juvenile steelhead each were marked each year for a total of over 500,000 fish. Adult returns to various recovery sites from 1982 releases are essentially complete. Recoveries from 1983 releases will be complete when 3-ocean fish return in 1986 and 1987.

2. Survival of control groups released in April 1982 was excellent to all recovery sites. The adult recovery rate was approximately 1.60% to Lower Granite Dam and a record high 0.75% to Dworshak NFH. The return of about 0.37% from 1983 releases of control fish represents a more normal return rate when compared to past hatchery returns. The unusually high survival from 1982 releases is probably a combination of high smolt survival to the collector dams, added survival from 57% of the control fish being transported from Lower Granite Dam in 1982 compared to 29% transported in 1983, and a higher rate of oceanic survival.

3. Homing was less impaired for releases made in 1983 as indicated by higher T/C ratios at the hatchery and fewer fish taken in the Zone 6 winter fishery than from the 1982 releases.

4. Survival of fish transported directly from the hatchery in 1982 was significantly enhanced as indicated by the approximate 4: 1 T/C ratio observed at Bonneville Dam and in the fall fishery in Zone 6.

5. Less survival enhancement was noted in returns from 1982 releases. This may have been because of the abnormally high rate of return of control fish resulting from a significant portion of them being transported from Lower Granite Dam in 1982.

6. Data obtained from both 1982 and 1983 releases suggest that maximum survival of Dworshak NFH steelhead is highest when releases are made between late April and early May and that direct barging from the hatchery has the potential for substantially increasing returns of Dworshak NFH steelhead to all recovery sites.

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APPENDIX A

Expenditure Information

SUMMARY OF EXPENDITURES 10/01/85 - 9/30/86

PROJECT 82-2

Use of Fish Transportation Barge for Increasing
Returns of Steelhead Imprinted for Homing

Personnel Services and Benefits	81.4
Travel & Transportation of Persons	4.7
Transportation of Things	7.8
Rent, Communications & Utilities	3.2
Printing & Reproduction	0.3
Contracts & Other Services	18.2
Supplies and Materials	4.1
Equipment	0.0
Grants	0.0
Support Costs (Including DOC ovhd.)	29.8
	<hr/>
TOTAL	149.5

APPENDIX B

Adult Recovery Summaries

Appendix Table B 1.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - CONTROL (C1)

STEELHEAD

Marks used - Brand: LAK-3

CWT: 23-6-6

Number juveniles released: 29,838

Date Released: 4-19-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	168	0.563
McNary	21	0.070
Lower Granite	489	1.639
River Sport		
Columbia R. below Snake R.	5	0.017
Columbia R. above Snake R.	1	0.003
Snake R.	40	0.134
Clear-water R.	66	0.221
Indian Fishery		
Fall Zone 6	138	0.462
Winter Zone 6	4	0.013
Clearwater	14	0.047
Ceremonial	1	0.003
Dworshak Hatchery	- 203	<u>0.680</u>
Totals	1,150	3.854

Appendix Table B 2.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - TEST (T1)

STEELHEAD

Marks used - Brand: RAL-4

CWT: 23-6-8

Number juveniles released: 33,012

Date Released: 4-19-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	149	0.451
McNary	53	0.161
Lower Granite	206	0.624
River Sport		
Columbia R. below Snake R.	5	0.015
Columbia R. above Snake R.	0	0.0
Snake R.	10	0.030
Clearwater R.	5	0.015
Indian Fishery		
Fall Zone 6	130	0.394
Winter Zone 6	23	0.070
Clearwater	5	0.015
Ceremonial	0	0.0
Dworshak Hatchery	125	<u>0.379</u>
Totals	711	2.154

Appendix Table B 3.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - TEST (T1A)

STEELHEAD

Marks used - Brand: RAL-3

CWT: 23-6-7

Number juveniles released: 32,185

Date Released: 4-19-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	121	0.376
McNary	24	0.074
Lower Granite	144	0.447
River Sport		
Columbia R: below Snake R.	7	0.022
Columbia R. above Snake R.	0	0.0
Snake R.	9	0.028
Clearwater R.	9	0.028
Indian Fishery		
Fall Zone 6	123	0.382
Winter Zone 6	27	0.084
Clearwater	5	0.016
Ceremonial	3	0.009
Dworshak Hatchery	107	<u>0.332</u>
Totals	579	1.799

Appendix Table B 4.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - CONTROL (C2)

STEELHEAD

Marks used - Brand: LAK-2

CWT: 23-16-4

Number juveniles released: 31,048

Date Released: 4-30-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	223	0.718
McNary	10	0.032
Lower Granite	495	1.594
River Sport		
Columbia R; below Snake R.	6	0.019
Columbia R. above Snake R.	0	0.0
Snake R.	55	0.177
Clearwater R.	68	0.219
Indian Fishery		
Fall Zone 6	140	0.451
Winter Zone 6	10	0.032
Clear-water	10	0.032
Ceremonial	0	0.0
Dworshak Hatchery	<u>255</u>	<u>0.821</u>
Totals	1,272	4.097

Appendix Table B 5.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - TEST (T2)

STEELHEAD

Marks used - Brand: RAL-2

CWT: 23-16-5

Number juveniles released: 32,911

Date Released: 4-30-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	329	1.000
McNary	49	0.149
Lower Granite	414	1.258
River Sport		
Columbia R. below Snake R.	10	0.030
Columbia R. above Snake R.	0	0.0
Snake R.	23	0.070
Clearwater R.	17	0.052
Indian Fishery		
Fall Zone 6	268	0.814
Winter Zone 6	83	0.252
Clearwater	10	0.030
Ceremonial	6	0.018
Dworshak Hatchery	<u>208</u>	<u>0.632</u>
Totals	1,397	4.245

Appendix Table B 6.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - CONTROL (C3)

STEELHEAD

Marks used - Brand: LAK-1

CWT: 23-16-2

Number juveniles released: 31,714

Date Released: 5-19-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	134	0.423
McNary	13	0.040
Lower Granite	331	1.04
River Sport		
Columbia R. below Snake R.	3	0.009
Columbia R. above Snake R.	0	0.0
Snake R.	18	0.057
Clearwater R.	36	0.114
Indian Fishery		
Fall Zone 6	105	0.331
Winter Zone 6	4	0.013
Clearwater	10	0.032
Ceremonial	0	0.0
Dworshak Hatchery	<u>130</u>	<u>0.410</u>
Totals	784	2.472

Appendix Table B 7.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - TEST (T3)

STEELHEAD

Marks used - Brand: RA)(-1

CWT: 23-16-3

Number juveniles released: 29,456

Date Released: 5-19-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	317	1.076
McNary	36	0.122
Lower Granite	291	0.988
River Sport		
Columbia R. below Snake R.	8	0.027
Columbia R. above Snake R.	0	0.0
Snake R.	10	0.034
Clear-water R.	7	0.024
Indian Fishery		
Fall Zone 6	184	0.625
Winter Zone 6	70	0.238
Clearwater	9	0.031
Ceremonial	9	0.031
Dworshak Hatchery	<u>168</u>	<u>0.570</u>
Totals	1,109	3.765

Appendix Table B 8.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1982. Data through July 1986.

1982 DWORSHAK - TEST (T4)

STEELHEAD

Marks used - Brand: RAL-1

CWT: 23-16-1

Number juveniles released: 31,915

Date Released: 5-31-82

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	62	0.194
McNary	17	0.053
Lower Granite	80	0.251
River Sport		
Columbia R. below Snake R.	2	0.006
Columbia R. above Snake R.	0	0.0
Snake R.	7	0.022
Clear-water R.	1	0.003
Indian Fishery		
Fall Zone 6	54	0.169
Winter Zone 6	14	0.044
Clearwater	2	0.006
Ceremonial	0	0.0
Dworshak Hatchery	43	<u>0.135</u>
Totals	282	0.884

Appendix Table B 9 --Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1983. Data through July 1986.

1983 DWORSHAK - CONTROL (C1)

STEELHEAD

Marks used - Brand: LAW-1

CWT: 23-16-38

Number juveniles released: 33,178

Date Released: 4-20-83

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	43	0.130
McNary	7	0.021
Lower Granite	212	0.639
River Sport		
Columbia R. below Snake R.	2	0.006
Columbia R. above Snake R.	0	0.0
Snake R.	20	0.060
Clearwater R.	35	0.105
Indian Fishery		
Fall Zone 6	48	0.144
Winter Zone 6	0	0.0
Clearwater	16	0.048
Ceremonial	0	0.0
Dworshak Hatchery	<u>95</u>	<u>0.286</u>
Totals	478	1.441

Appendix Table B10.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1983. Data through July 1986.

1983 DWORSHAK - TEST (1)

STEELHEAD

Marks used - Brand: RAF-1

CWT: 23-16-40

Number juveniles released: 30,341

Date Released: 4-20-83

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	121	0.399
McNary	47	0.155
Lower Granite	409	1.348
River Sport		
Columbia R. below Snake R.	10	0.033
Columbia R. above Snake R.	0	0.0
Snake R.	26	0.086
Clearwater R.	42	0.138
Indian Fishery		
Fall Zone 6	151	0.498
Winter Zone 6	5	0.016
Clearwater	44	0.145
Ceremonial	0	0.0
Dworshak Hatchery	<u>165</u>	<u>0.544</u>
Totals	1,020	3.362

Appendix Table B11.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1983. Data through July 1986.

1983 DWORSHAK - TEST (1A)

STEELHEAD

Marks used - Brand: RAZ-1

CWT: 23-16-39

Number juveniles released: 28,658

Date Released: 4-20-83

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	158	0.551
McNary	50	0.174
Lower Granite	422	1.473
River Sport		
Columbia R. below Snake R.	14	0.049
Columbia R. above Snake R.	0	0.0
Snake R.	31	0.108
Clearwater R.	28	0.098
Indian Fishery		
Fall Zone 6	182	0.635
Winter Zone 6	9	0.031
Clearwater	40	0.140
Ceremonial	1	0.003
Dworshak Hatchery	<u>170</u>	<u>0.593</u>
Totals	1,105	3.857

Appendix Table B 12.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1983. Data through July 1986.

1983 DWORSHAK - CONTROL (C2)

STEELHEAD

Marks used - Brand: LAW-2

CWT: 23-16-16

Number juveniles released: 32,236

Date Released: 5-3-83

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	21	0.065
McNary	0	0.0
Lower Granite	188	0.583
River Sport		
Columbia R. below Snake R.	2	0.006
Columbia R. above Snake R.	0	0.0
Snake R.	9	0.028
Clearwater R.	28	0.087
Indian Fishery		
Fall Zone 6	34	0.105
Winter Zone 6	1	0.003
Clearwater	8	0.025
Ceremonial	0	0.0
Dworshak Hatchery	88	<u>0.273</u>
Totals	379	1.176

Appendix Table B13.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1983. Data through July 1986.

1983 DWORSHAK - CONTROL (C2A)

STEELHEAD

Marks used - Brand: RAF-3

CWT: 23-16-19

Number juveniles released: 31,956

Date Released: 5-3-83

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	31	0.097
McNary	2	0.006
Lower Granite	180	0.563
River Sport		
Columbia R. below Snake R.	2	0.006
Columbia R. above Snake R.	0	0.0
Snake R.	15	0.047
Clearwater R.	32	0.100
Indian Fishery		
Fall Zone 6	61	0.191
Winter Zone 6	2	0.006
C l e a r w a t e r	10	0.031
Ceremonial	0	0.0
Dworshak Hatchery	95	<u>0.297</u>
Totals'	430	1.346

Appendix Table B14.- Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1983. Data through July 1986.

1983 DWORSHAK. - TEST (.T2)

STEELHEAD

Marks used - Brand: RAF-2

CWT: 23-16-17

Number juveniles released: 32,465

Date Released: 5-3-83

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	131	0.404
McNary	40	0.123
Lower Granite	446	1.374
River Sport		
Columbia R. below Snake R.	17	0.052
Columbia R. above Snake R.	0	0.0
Snake R.	20	0.062
Clearwater R.	31	0.095
Indian Fishery		
Fall Zone 6	1.76	0.542
Winter Zone 6	18	0.055
Clearwater	39	0.120
Ceremonial	0	0.0
Dworshak Hatchery	<u>171</u>	<u>0.527</u>
Totals	1,089	3.354

Appendix Table B16.--Preliminary summary of adult steelhead marked as juveniles at Dworshak National Fish Hatchery in 1983. Data through July 1986.

1983 DWORSHAK- TEST (T3)

STEELHEAD

Marks used - Brand: LAW-3

CWT: 23-16-18

Number juveniles released: 31,906

Date Released: 5-24-83

<u>Recovery Area</u>	<u>No. of Returns</u>	<u>Percent Return</u>
Adult Trapping Facilities		
Bonneville	12	0.038
McNary	4	0.013
Lower Granite	45	0.141
River Sport		
Columbia R. below Snake R.	0	0.0
Columbia R. above Snake R.	0	0.0
Snake R.	2	0.006
Clearwater R.	1	0.003
Indian Fishery		
Fall Zone 6	16	0.050
Winter Zone 6	2	0.006
Clearwater	0	0.0
Ceremonial	0	0.0
Dworshak Hatchery	21	<u>0.066</u>
Totals	103	0.323